GS07 1015 - Microbial Genetics and Physiology – Spring 2020 semester
M-F: 9:00-10:30 AM, MSB 1.180
Course Director: Peter Christie, MSB1.192 Peter.J.Christie@uth.tmc.edu 713-500-5440

The objective of this course is to provide our second-semester, first-year students with a broad knowledge of genetics and physiology as they pertain specifically to prokaryotic and eukaryotic microbes. Topics covered include genetics, gene expression, cell division, cell structure and biogenesis, energy and metabolism, signaling and development, stress responses, and pathogenesis (virulence factors and host response). The course is divided into 15 one-week units composed of at least two faculty-led lectures and two roundtable discussions of the primary literature. Grades are based on participation (25%), writing exercises focused on the papers discussed in class (50%), and a weekly problem set (25%).

Weekly schedule:

Monday
9:00-10:30: Lecture

E-mail completed problem set to the previous week's instructor by midnight Monday night.

Tuesday
Pre-class assignment for Tuesday: Students should prepare to discuss paper #1 and complete a written exercise (see below), which is e-mailed to the instructor before Tuesday's class. If supplementary files are part of the paper under discussion, students should prepare to discuss this material as well.

9:00-10:30: Paper #1 Round-table discussion. Every student is responsible for presenting a figure or section of the paper.

Wednesday
9:00-10:30: Lecture

Thursday
Pre-class assignment for Thursday: Students should prepare to discuss paper #2 and complete a written exercise (see below), which is e-mailed to the instructor before Thursday's class.

9:00-10:30: Paper #2 Round-table discussion. Every student is responsible for presenting a figure or section of the paper.

Friday
9:00-10:30: The instructor chooses one or more of the following options:
1) Another lecture
2) Instructor presents paper #3, or a methodology
3) Discuss current problems, future directions, or technical challenges in the topic area
4) Discuss Thursday's seminar – For example: What question did each student want to ask the speaker?

Problem Set: This take-home problem set is provided in class or by e-mail by noon on Friday. The completed problem set is due before midnight Monday night by e-mail to the Instructor.

Grading:

Writing exercise: 10 points each (max.), two each week.
Problem set: 10 points each (max.)
Participation: 10 points each week (max.)
Each week: 40 points max. Sum of 2 writing exercises, 1 problem set, 1 participation grade
Total course: 600 points max. for the 15 week course (40 points/wk X 15 wks)

Each week the instructor(s) submits a score for each student to the course director.

One-Page Writing Exercises: (Each writing exercise is 10 pts. max.).
These exercises are based on the papers discussed in class (see above). The goal is to help each student gain the critical thinking skills that will be useful in preparing the specific aims and mini-grant in the Topics in Microbiology course (Fall semester second year).

The discussion papers are provided by the instructors on-line (Canvas) at least two weeks before the class. The completed assignments should be no more than 1 page. It is suggested to use Arial 11, single-spaced and 1 inch margins. Correct prose and complete sentences are expected. Label the file with your last name, week and paper #.

Block I: *A) Provide a short description of the paper. B) Describe what you think is the most important experiment and why. C) Describe what experiment you would do next.*

Block II: *A) Provide a short description of the paper. B) Write a NEW hypothesis based on that paper. C) Describe some experiments that address the hypothesis.*

Block III: *A) Provide a short description of the paper. B) Write a central hypothesis based on the paper. C) Provide 2-3 formal aims to address the hypothesis.*

Problem Set: (Each problem set is 10 pts. max.).
The take-home problem set based on the week's material is provided in class or by e-mail by Friday at noon. The completed assignment is due by midnight Monday evening by e-mail to the Instructor. Label the file with your last name and week. The problems require thinking, not repeating the week's material.

The instructor(s) will return the graded homework electronically or in class by the following Monday. The grades will also be forwarded to the course director (Peter Christie). If students require clarification or help they should contact the instructor to schedule a meeting.

Course Content:

Block I

Week 1 (1/06-1/10): (**MBID Retreat Jan 10**) Bacterial genetics (Kaplan)

- Screens, Selections, and Inheritance
- Genetic Analysis of the Lac Operon
- Mapping mutations
- Learning activity: Three factor crosses and complete Table 4 Mapping by Hfr and co-transduction

Week 2 (1/13-17): Metabolism (Koehler (.5), Lorenz (.5))

- Central biochemical pathways
- Respiration, fermentation, and anaerobiosis
- Nutrient uptake

Week 3 (1/21-1/24): **MLK Holiday Monday.** Wonderful world of parasites (Li)

- Parasite life cycle and biology
- Genetic methods in parasites

Week 4 (1/27-1/31): Growth, Division and Signaling (Margolin (.75), Kaplan (.25))

- Cell Division in Prokaryotes
- Cell cycle regulation
- Cell division and growth rate

Week 5 (2/3-2/7) Fungal genetics and cell biology (Kim (.75), Van Hoof (.25))

- Classical and reverse genetics of fungi
- High-throughput genetic analysis in yeast
- Mating and differentiation
- Yeast Genetics to Human Disease: Yeast as a model eukaryote

Block II

- Week 6 (2/10-2/14) Bacterial cell structures (Konovalova)
- Cell biology of bacteria and phage
- Cytoskeleton, membrane and cell wall
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Week 7 (2/18-2/21): **President's Day Holiday Monday** Bacterial gene expression (highlighted via nutrient sensing and response) (Koehler (.50), De Lay (.50))

- General mechanisms of nutrient sensing and response
- Catabolite repression
- Stringent response and oxidative stress

Week 8 (2/24-2/28): Bacterial secretion/molecular machines (Christie (.50), Hu (.50))

- General secretory pathways
- Dedicated protein/DNA transfer systems
- Post-secretory protein modification

Week 9 (3/2-3/6): Stress response (De Lay (.50), Morano (.50))

- The general stress response activator: small RNAs
- Promoting tolerance: protein folding and heat shock response (protein methods: pulse-chase labeling, protein gels etc.)

Week 10 (3/9-3/13): Differentiation and Multicellularity (Margolin (.75), Kaplan (.25))

- Cell differentiation

- Sporulation
- Biofilms
- Symbiosis

GSBS SPRING BREAK (3/16-3/20)

Block III

Week 11 (3/23-3/27): Microbial virulence – what is it and how do we study it? (Lorenz (.50), Garsin (.50))

- Defining and measuring virulence
- Using model hosts to identify virulence factors
- Genetic and genomic approaches for identifying virulence factors

Week 12 (3/30-4/3): Virulence mechanisms (Koehler (.6), Krachler (.4))

- Adherence and invasion
- Toxins
- Translocated effectors

Week 13 (4/6-4/10): Mechanisms for combatting microbial infections (Garsin, Arias)

- Antimicrobials and resistance
- Vaccination

Week 14 (4/13-4/17): Antimicrobial immunity (Norris)

- Innate immunity system
- Adaptive immunity system

Immune evasion

Week 15(4/20-4/24): Microbiome (Krachler)

- Microbiome profiles of disease, treatment response, and environmental changes
- Mechanisms for combatting microbial infections
- Methods for study

MMG RETREAT (4/30-5/1)